

CLAIMS

What is claimed is:

1. A die carrier, comprising:
a body comprising a primary surface adapted for attachment to a substrate die and at least partially defining a fluid chamber;
a fill port fluidically connected to the fluid chamber; and
an evacuate port fluidically connected to the fluid chamber.
2. The die carrier according to Claim 1, further comprising a check valve arranged in at least one of the fill port or the evacuate port.
3. The die carrier according to Claim 1, further comprising:
a compliant diaphragm arranged in the body, the diaphragm having a surface in fluid communication with the fluid chamber.
4. The die carrier according to Claim 1, wherein the die carrier has a heat conductivity greater than the substrate die.
5. The die carrier according to Claim 1 comprising:
a first check valve arranged in the fill port and a second check valve arranged in the evacuate port.
6. A die carrier according to Claim 1, wherein the body comprises surface area extending elements.
7. The die carrier according to Claim 6, wherein the surface area extending elements comprise at least one of external vanes or channels.
8. The die carrier according to Claim 1, comprising a reference datum.

9. The die carrier according to Claim 1, comprising a septum arranged in at least one of the fill port or the evacuate port.

10. The die carrier according to Claim 1, wherein the body comprises a surface portion with a primary surface adapted for attachment to a substrate die and a fill plate comprising a fill port and an evacuate port, the surface portion having a first coefficient of thermal expansion, the fill plate having a second coefficient of thermal expansion and the substrate die having a third coefficient of thermal expansion which is closer to the first coefficient of thermal expansion than to the second coefficient of thermal expansion.

11. A fluidic MEMS device, comprising:
a MEMS sub-assembly comprising a substrate die with a MEMS structure fabricated on an upper surface of the substrate die and a cover plate;
a die carrier comprising a body having a primary surface and at least partially defining a fluid chamber, a fill port fluidically connected to the fluid chamber, and an evacuate port fluidically connected to the fluid chamber;
wherein the MEMS sub-assembly is attached to the primary surface of the die carrier.

12. The fluidic MEMS device according to Claim 11 comprising a check valve arranged in at least one of the fill port or the evacuate port

13. The fluidic MEMS device according to Claim 11, further comprising:
a compliant diaphragm arranged in the body and having a surface in fluid communication with the fluid chamber.

14. The fluidic MEMS device according to Claim 11, comprising means for removing heat from the MEMS sub-assembly.

15. The fluidic MEMS device according to Claim 11, wherein the cover plate is attached to the substrate by a bond.

16. The fluidic MEMS device according to Claim 15, wherein the substrate die, the cover plate and the bond define an inner cavity, the inner cavity being in fluid communication with the fluid chamber through a pathway from an underside of the substrate die to an upper surface of the substrate die.

17. The fluidic MEMS device according to Claim 16, wherein:
the inner cavity is in fluid communication with the fluid chamber through at least one of a plurality of a plurality of pathways from the underside of the substrate die to the upper surface of the substrate die.

18. The fluidic MEMS device according to Claim 11, wherein the body comprises surface area extending elements.

19. The fluidic MEMS device according to Claim 18, wherein the surface area extending elements comprise at least one of vanes or channels.

20. The fluidic MEMS device according to Claim 11, comprising a septum arranged in one of the fill port or the evacuate port.

21. A method of filling a fluidic MEMS device with fluid, comprising:
connecting a fluid source at a fill port of the MEMS device;
providing a differential pressure between the fill port and an evacuate port of the MEMS device, causing fluid from the fluid source to be drawn into the MEMS device and air and gas from the MEMS device to be evacuated through the evacuate port.

22. The method of Claim 21, wherein providing the differential pressure comprises providing fluid under pressure at the fill port.

23. The method of Claim 21, wherein providing the differential pressure comprises providing a vacuum at the evacuate port.

24. The method of Claim 21, wherein providing the differential pressure comprises providing fluid under pressure at the fill port and providing a vacuum at the evacuate port.

25. A method of assembling a fluidic MEMS device comprising:
singulating a MEMS sub-assembly from a wafer-level MEMS assembly;
joining the MEMS sub-assembly to a die carrier, the die carrier comprising a fluid chamber, a fill port and an evacuate port.

26. The method of Claim 25, wherein the MEMS sub-assembly comprises a substrate die, a bond and a cover plate, wherein the cover plate, the substrate die and the bond define an inner cavity.

27. The method of Claim 25, wherein the joining comprises:
joining the MEMS sub-assembly to the die carrier by adhesive.

28. The method of Claim 27, wherein the adhesive is disposed in a recess in the die carrier.

29. The method of Claim 25, comprising:
aligning the MEMS sub-assembly with the die carrier with an alignment process using at least a reference datum on the die carrier.

30. A display device, comprising:
a substrate die with an upper surface;
a mirror array fabricated on the upper surface of the substrate die; and
an optical aperture attached to the substrate die by a bond;
wherein the substrate die is attached to a primary surface of a die carrier, the die carrier comprising a body defining a fluid chamber, a fill port fluidically connected to the fluid chamber, and an evacuate port fluidically connected to the fluid chamber.

31. The display device according to Claim 30, comprising a check valve arranged in one of the fill port or the evacuate port.

32. The display device according to Claim 30, further comprising:
a compliant diaphragm arranged in the body and having a surface in fluid communication with the fluid chamber.

33. The display device according to Claim 30, wherein the die carrier has a heat conductivity greater than the substrate die.

34. The display device according to Claim 30, comprising:
an inner cavity defined by the substrate die, the optical aperture and the bond; and
a pathway from an underside of the substrate die to an upper surface of the substrate die, the inner cavity being in fluid communication with the fluid chamber through the pathway.

35. The display device according to Claim 34, wherein the inner cavity is in fluid communication with the fluid chamber through at least one of a plurality of pathways from the underside of the substrate die to the upper surface of the substrate die.

36. The display device according to Claim 30, wherein the body comprises surface area extending elements.

37. The display device according to Claim 30, comprising a septum arranged in one of the fill port or the evacuate port.

38. A die carrier, comprising:

a body at least partially defining a fluid chamber, the body having a primary surface adapted for attachment to a substrate die;

means for defining a first fluid path to the fluid chamber filling the fluid chamber; and

means for defining a second fluid path to the fluid chamber.

39. The die carrier according to Claim 38, comprising means for preventing fluid from leaving the fluid chamber through at least one of the first fluid path to the fluid chamber or the second fluid path to the fluid chamber.

40. A die carrier, comprising:

a body having a primary surface adapted for attachment to a substrate die and at least partially defining a fluid chamber;

a fill port fluidically connected to the fluid chamber;

an evacuate port fluidically connected to the fluid chamber; and

means for accommodating thermal expansion of fluid in the fluid chamber.